

Key to the *Macrophya zhaoae* group (Hymenoptera, Tenthredinidae) with description of a new species from China

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Abstract

The *Macrophya zhaoae* group is reviewed and five species are recognized in China, including a newly described species, *M. lishuii* Li, Liu & Wei **sp. nov.** from Zhejiang Province, and four previously known species, *M. hainanensis* Wei & Nie, 2002, *M. minutithec*a Wei & Nie, 2002, *M. nigrospuralina* Wei, 2005 and *M. zhaoae* Wei, 1997. A key to all Chinese species and a distribution map of the *M. zhaoae* group in China are provided.

Key Words

Hymenoptera, *Macrophya zhaoae* group, sawflies, taxonomy, Tenthredinoidea

Introduction

Macrophya Dahlbom, 1835 is the third largest genus in the subfamily Tenthredininae (Hymenoptera, Tenthredinidae). It contains 309 species worldwide, of which 170 have been recorded in China up to December 2019 (Li et al. 2019a, 2019b; Liu et al. 2019a, 2019b, 2019c).

The *Macrophya zhaoae* group is a small species group in *Macrophya*, with four extant species worldwide, all of which are present in China. Among them, *M. hainanensis* Wei & Nie, 2002 from Hainan Province (Wei and Nie 2002a), *M. minutithec*a Wei & Nie, 2002 from Guizhou Province (Wei and Nie 2002b), *M. nigrospuralina* Wei, 2005 from Guizhou and Hubei Provinces (Wei 2005) and *M. zhaoae* Wei, 1997 from Hubei and Zhejiang Provinces (Wei and Ma 1997). The species of the *Macrophya zhaoae* group are all similar in general morphology and constitute a clearly defined species group in *Macrophya*. In this study, a new species belonging to this species

group is described from China, named *Macrophya lishuii* Li, Liu & Wei, sp. nov. According to the available data, species in this group are mainly distributed in southern China. A key to all species found in China is provided.

Materials and methods

The specimens of the newly described species were obtained by sweeping in forest fringe zones in Zhejiang Province at Mt. Jiulong (Eastern China) in May 2019. The Mt. Jiulong (28°23.640'N, 118°50.700'E) reaching 1724 meters above sea level is the fourth highest mountain in Zhejiang Province and belongs to the Wuyi mountain system. Three specimens of the new species and seven specimens of other species of the *Macrophya zhaoae* group were examined and studied for this work. The specimens were examined with a Motic-SMZ-171 stereomicroscope. Images of the imagines were taken with

a Nikon D700 digital camera and a Leica Z16APO. The genitalia were examined with a Motic BA410E microscope and photographed with Motic Moticam Pro 285A. Images were focus-stacked using Helicon Focus (HeliconSoft, Kharkiv, Ukraine) and further processed with Adobe Photoshop CS 11.0.

The terminology of genitalia follows Ross (1945) and that of general morphology follows Viitasaari (2002). For a few terms (e.g. middle fovea and lateral fovea), we follow Takeuchi (1952).

The specimens of four known species examined in this study are deposited in the Insect Collection of Central South University of Forestry and Technology, Changsha, Hunan, China (CSCS). The holotype is deposited in the Scientific Research and Management Center of East China Pharmaceutical Botanical Garden, Lishui, Zhejiang, China (formerly Lishui Academy of Forestry, LSAF).

Abbreviations

- OOCL** The distance between a lateral ocellus and the occipital carina, or the hind margin of the head where this carina would be if it was developed (Benson, 1954).
- OOL** The shortest distance between an eye and a lateral ocellus.
- POL** The distance between the mesal margins of the two lateral ocelli.

Results

Macrophya zhaoae species group

Diagnosis. The *Macrophya zhaoae* group is a small species group, well defined by morphological characters within *Macrophya*. A diagnosis of the *M. zhaoae* group including body length, body color, morphological characters of body parts and external genitalia was provided by Li et al. (2018). Species of the *M. zhaoae* group can be recognized by the following characters (Li et al. 2018): body mainly black, some apical segments bright yellowish-white; fore and middle legs yellowish-brown, hind leg yellowish-brown to orange-brown; face and frontal area distinctly depressed, top of middle ocellus distinctly lower than upper margin of compound eye; the postocellar area flat, clearly less than twice as broad as

long; posterior corner of metepimeron without appendage; metabasitarsus sturdy, claw of hind tibia with inner tooth broader and longer than outer tooth.

Description. Body mainly black. The following parts are always yellowish-white: palps mostly, center of mandibles, labrum, clypeus, postocellar area, antennomeres 7–9 at least, posterior margin and large maculae on lateral corners of pronotum, apical margin of tegula at least, double triangular maculae on bottom of prescutum, lateral round maculae on mesoscutellum, post tergite mostly, cenchrus, narrow macula on posterior margin of anepimeron, a large macula of katepimeron and a row of lateral maculae on abdominal terga 1–7 (8). Legs mostly orange-brown, parts black. Body hairs dense and short, mostly silver; setae on ovipositor sheath curved and long, blackish-brown. Wings hyaline, most veins and pterostigma blackish-brown. Vertex more or less shiny. Labrum elevated medially, anterior margin slightly truncate; clypeus roundly elevated, base clearly broader than distance between lower corners of eyes, lateral sides distinctly convergent apically, anterior margin shallowly incised to approximately 1/4–1/3 of its length, lateral corners somewhat short and broad, apical margins of lobe obtuse; malar space linear, approximately 0.5× breadth of diameter of middle ocellus; frontal area and face clearly depressed, lower than top of upper margin of compound eye in lateral view; head narrowed behind eyes in dorsal view, occipital carina complete. Antenna slender, middle antennomeres more or less inflated. Mesoscutellum elevated, higher than top of mesonotum in lateral view; posterodorsal platform of mesepimeron as broad as diameter of middle ocellus; metepimeronal appendage with a small platform-shaped area; distance between cenchri 2.5×–3.0× breadth of a cenchrus. Inner tibial spur of hind leg approximately 0.6× length of metabasitarsus, claw with inner tooth slightly longer and clearly broader than outer tooth. Ovipositor sheath shorter than metabasitarsus, setae on ovipositor sheath curved and long in dorsal view, apical margin roundish in lateral view. Fore wing with cross-vein cu-a joining cell 1M in basal 1/3–2/5, petiole of anal cell slightly shorter than cross-vein 1r-m; petiole of anal cell in hind wing 1/4–2/5 length of cross-vein cu-a.

In China, the *Macrophya zhaoae* group includes a new species from Zhejiang Province described here (the collection site of the new species at Mt. Jiulong is shown in Figure 3) and another four species from Guizhou, Hainan, Hubei and Zhejiang Provinces, China. They can be separated using the following key.

Key to the Chinese species of the *Macrophya zhaoae* group

- 1 Body length 10–11 mm; mesoscutellum with sparse large punctures, center with complete and long black stripe in longitudinal direction; hind femur and apex of hind tibia with black maculae; below pterostigma in apical 1/3 of fore wing with smoky macula; middle serrulae with minute teeth. China (Hubei, Zhejiang) *M. zhaoae* Wei, 1997
- Body length 13–15 mm; other characters not different from the former 2
- 2 Hind femur mostly orange-brown, apex with distinct black maculae 3
- Hind femur entirely orange-brown 4

- 3 Center of mesepisternum with large white macula; basal half of hind coxa black, apical half yellowish-brown; anal petiole in fore wing shrunk as long spot-shaped; ovipositor sheath as long as metabasitarsus. China (Hainan) *M. hainanensis* Wei & Nie, 2002
- Mesepisternum entirely black; basal margin of metabasitarsus black, otherwise pale yellowish-brown; anal petiole in fore wing long; ovipositor sheath as long as 0.5× length of metabasitarsus. China (Guizhou)..... *M. minutithec*a Wei & Nie, 2002
- 4 Apical antennomeres 7–9 of antenna entirely yellowish-white; center of mesoscutellum with complete and long black stripe in longitudinal direction; hind femur mostly orange-brown, apex on dorsal surface with small macula; apex of fore coxa, apical 2/5 of middle coxa and apex of hind coxa with yellowish-white maculae; posterior margins of all abdominal terga with weak maculae, but not yellowish-white; lancet with 18 serrulae, roundish protruding, subbasal teeth minute, without proximal or distal teeth. China (Guizhou, Hubei)..... *M. nigrospuralina* Wei, 2005
- Apical antennomeres 6–9 of antenna entirely yellowish-white (Figure 1f); hind femur entirely orange-brown (Figure 1a, b); apical parts of fore and middle coxae mostly and apical 1/3 of hind coxa with yellowish-white maculae (Figure 1a, b); posterior margins of abdominal terga 1–8 with long maculae, distinct yellowish-white (Figure 1a, b, h); lancet with 20 serrulae (Figure 1j), sub-triangularly protruding, middle serrulae with 1 proximal and 3–6 distal teeth (Figure 1k). China (Zhejiang)..... *M. lishuii* Li, Liu & Wei, sp. nov.

Taxonomy

Macrophya hainanensis Wei & Nie, 2002

Macrophya hainanensis Wei & Nie, 2002. Forest Insects of Hainan, 837. Type locality: China: Hainan.

Diagnosis. The species is morphologically similar to *M. minutithec*a, i.e. the center of mesepisternum with large white macula; basal half of hind coxa black, apical half yellowish-brown; anal petiole in fore wing shrunk as long spot-shaped; sheath as long as metabasitarsus.

Type material. Holotype. ♀, China, Hainan Province, Mt. Jianfengling, Meicai Wei & Haiyan Nie leg.

Host plants. Unknown.

Distribution. China (Hainan).

Macrophya lishuii Li, Liu & Wei, sp. nov.

<http://zoobank.org/FC03E0C3-E3E0-48FE-BE35-6B5B89F4131A>

Figure 1

Type locality. China: Zhejiang.

Type material. Holotype. ♀ (LSAF19027), China, Zhejiang Province, Lishui City, Suichang County, Mt. Jiulong, Jiulong Hotel, 28°23.640'N, 118°50.700'E, alt. 482 m, 24.V.2019, Zejian Li leg., ethylacetate; Paratypes. 2♀, same date as holotype.

Diagnosis. The new species is similar to *M. nigrospuralina* in external morphological characters, i.e. the apical antennomeres 6–9 of antenna entirely yellowish-white; hind femur entirely orange-brown; apical parts of fore and middle coxae and apical 1/3 of hind coxa with yellowish-white maculae; posterior margins of abdominal terga 1–8 with long maculae, distinct yellowish-white; lancet with 20 serrulae, sub-triangularly protruding, middle serrulae with 1 proximal and 3–6 distal teeth.

Description. Female. Body length 15 mm. Body mostly black. The following parts are yellowish-white: palp mostly, center of mandibles, labrum, clypeus, postocellar

area, narrow macula on outer margin of eyes, antennomeres 6–9 except base of antennomere 6 with some black macula, posterior margin and large maculae on lateral corners of pronotum, apical half of tegula, double triangular maculae on bottom of prescutum, lateral round maculae on mesoscutellum, post tergite mostly, metascutellum except a black macula, cenchrus, narrow macula on posterior margin of anepimeron, a large macula of katepimeron, narrow macula on posterior margin and a small macula on posterior corner of metepimeron, a row of lateral maculae on abdominal terga 1–8 (the widest macula of abdominal tergum 1, the narrowest macula of abdominal tergum 8), posterior margins of abdominal terga 1–8 with long maculae (macula full between posterior margins and lateral maculae of abdominal terga 1–2, the narrowest macula with long macula of abdominal tergum 8), long triangular macula on posterior margin of abdominal tergum 10. Legs mostly orange-brown; fore and middle coxae except bases with black maculae, apical 1/3 and outer surface with an oval macula of hind coxa and all trochanters yellowish-white; apical dorsum of hind femur, apical parts of hind tibia (black macula on inner surface 1/4 length of hind tibia) and claw of hind tibia black. Body hairs dense and short, mostly silver; setae on ovipositor sheath curved and long, blackish-brown. Wings hyaline, apical 1/3 of fore wing smoky roundish below pterostigma, most veins and pterostigma blackish-brown. (Figure 1a, b)

Vertex less shiny than in *M. nigrospuralina*; frontal area shallowly and sparsely punctured, smooth interspaces distinct and smooth, microsculpture weak (Figure 1c); labrum and clypeus less shiny, punctures on its surfaces sparse and shallow, microsculpture weak (Figure 1d). Mesonotum less shiny, punctures on mesonotum smaller and denser than punctures on head, interspaces distinct and smooth; center of mesoscutellum with some large punctures, interspaces broader than diameter of a puncture; mesoscutellar appendage mostly and metascutellum entirely smooth and shiny, but bottom of mesoscutellar appendage with weak microsculpture and sparse shallow punctures; metascutellum dull, without distinct punc-

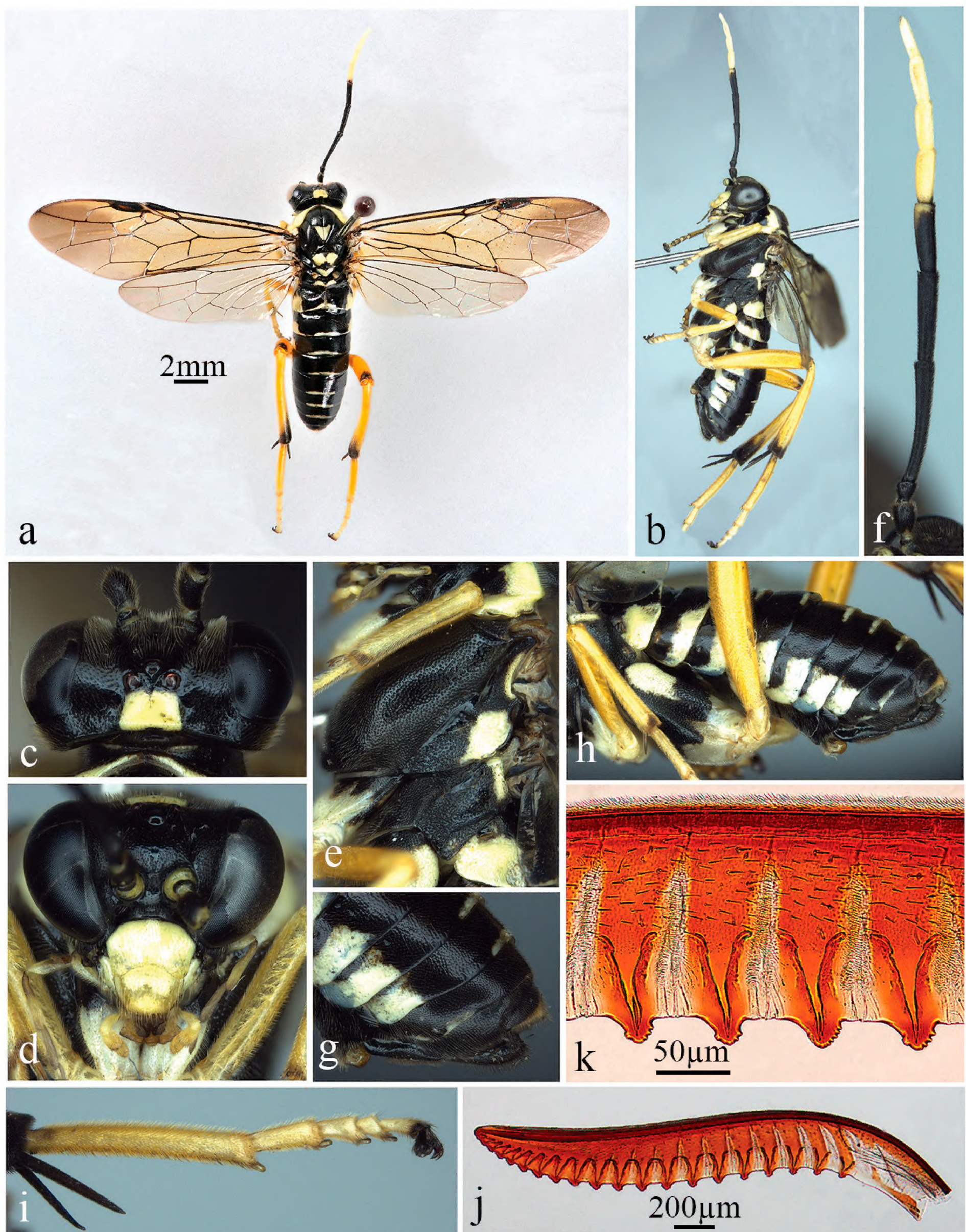


Figure 1. *Macrophya lishuii* sp. nov., ♀, holotype. **a.** Female adult, dorsal view; **b.** Female adult, lateral view; **c.** Head of female, dorsal view; **d.** Head of female, frontal view; **e.** Mesopleuron and metapleuron of female; **f.** Antenna of female, lateral view; **g.** Ovipositor sheath, lateral view; **h.** Abdomen, lateral view; **i.** Hind tarsus and claw of female, lateral view; **j.** Lancet; **k.** The 7th–9th serrulae. Scale bars: 2 mm (a); 200 µm (j); 50 µm (k).

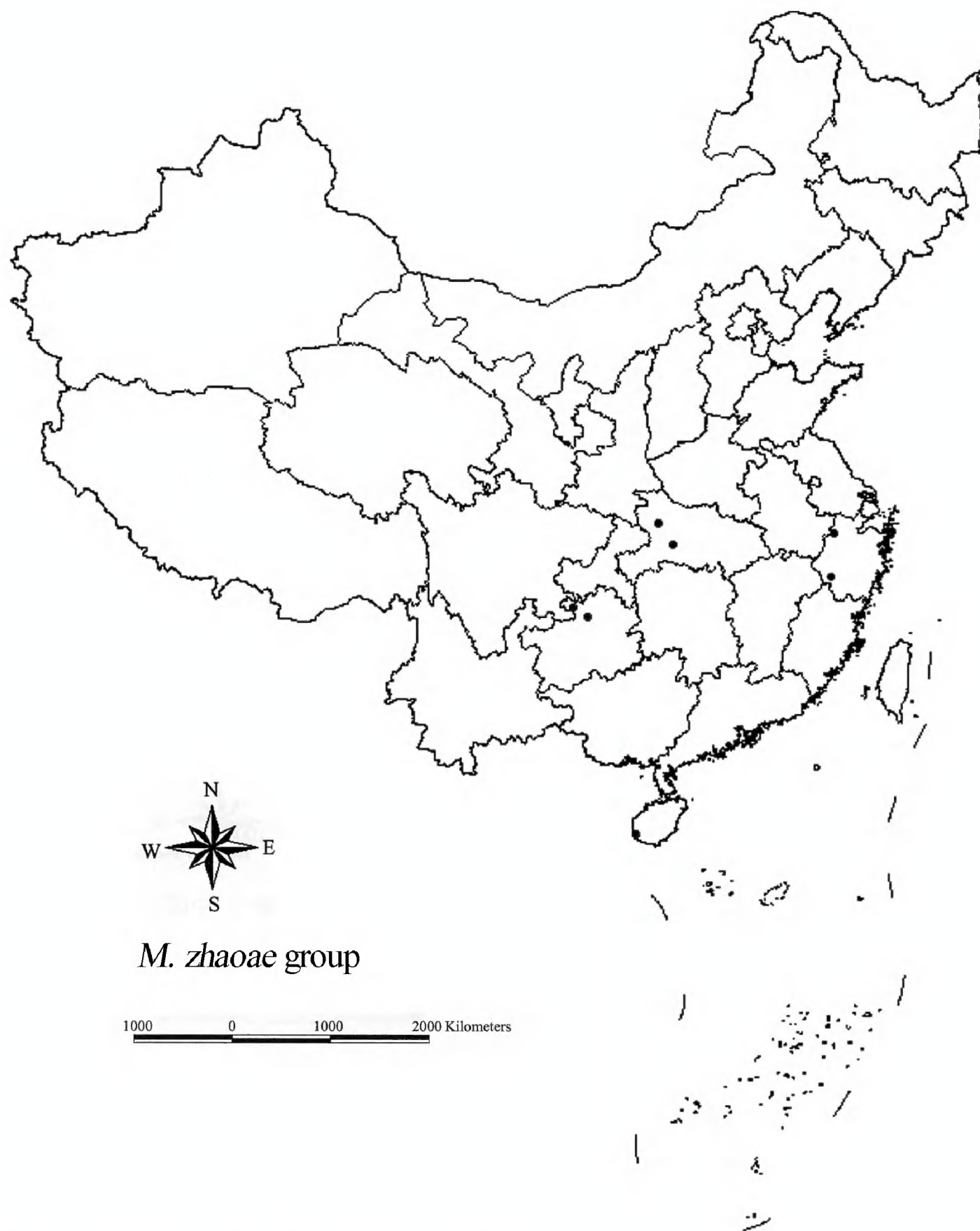


Figure 2. Geographical distribution map of *M. zhaoae* group in China.

tures, but with weak microsculpture. Mesopleuron less shiny, mesepisternum with dense and coarse punctures, upper half with punctures large and interspaces broad, lower half with punctures small and interspaces narrow; anepimeron dull, with coarse wrinkles; anterior margin of katepimeron very smooth and shiny, without punctures or microsculpture, posterior area of katepimeron with some shallow large punctures, dorsal half with some deep punctures; metepisternum dull, with minute and dense punctures; metepimeron less shiny, depressed area with some punctures and weak microsculpture, interspaces broader than diameter of a puncture, without metepimeronal appendage (Figure 1e). Abdominal tergum 1 shiny, laterally abdominal tergum 1 with some shallow punctures, nearly smooth submedially, basal 1/3 of abdominal tergum 1 punctured and 2/3 smooth; other abdominal terga less shiny, anterior 2/3 with some shallow punctures and weak

microsculpture, posterior 1/3 smooth, abdomen in lateral view as shown in Figure 1h. Outer surface of hind coxa with somewhat dense and coarse punctures, outer surface of hind femur with sparse shallow punctures and fine microsculpture. Surface of ovipositor sheath coriaceous, with indistinct punctures and fine microsculpture.

Labrum elevated medially, anterior margin slightly truncate; clypeus roundishly elevated, base clearly broader than distance between lower corners of eyes, lateral sides distinctly convergent apically, anterior margin shallowly incised to approximately 1/4 of its length, lateral corners somewhat short and broad, margins of lobe obtuse (Figure 1d); malar space linear, approximately 0.5× as broad as diameter of middle ocellus; frontal area and face clearly depressed, lower than top of upper margin of compound eye in lateral view; middle fovea weak, pot-shaped, lateral foveae clear, furrow-like;



Figure 3. a, b. Habitat of the new species: the collection site at Mt. Jiulong in Zhejiang Province, China.

interocellar furrow shallow, postocellar furrow weak; POL: OOL: OOCL = 31: 56: 43; postocellar area weakly elevated, approximately 1.5× broader than long; lateral furrow somewhat broad and shallow, divergent posteriorly; head narrowed behind eyes in dorsal view, occipital carina complete. Antenna slender (Figure 1f), approximately 1.64× length of head and thorax together (11.5: 7), approximately 1.15× length of abdomen (11.5: 10); antennomere 2 approximately 1.3× as long as breadth; antennomere 3 approximately 1.25× length of antennomere 4 (25: 20), approximately 0.7× length of antennomeres 4 and 5 together (25: 35), middle antennomeres weakly inflated, subapical antennomeres weakly compressed, ratio of antennomeres 6: 7: 8: 9 as 11: 11: 10: 9. Mesoscutellum elevated, bottom of it with peak, weak median ridge or carina, higher than top of mesonotum in lateral view; mesoscutellar appendage with middle longitudinal carina; metascutellum with short and low carina; posterodorsal platform of mesepimeron as broad as diameter of middle ocellus; metepimeronal appendage with a small platform-shaped area; distance between cenchri 2.5× breadth of a cenchrus; mesopleuron and metapleuron as shown in Figure 1e. Inner tibial spur of hind leg 0.6× length of metabasitarsus (26: 43); metabasitarsus slender, approximately 1.3× length of following four tarsomeres together (43: 34); claw with inner tooth slightly longer and clearly broader than outer tooth, hind tarsus as shown in Figure 1i. Ovipositor sheath shorter than metabasitarsus (35: 43), apical sheath as long as basal sheath, setae on ovipositor sheath curved and long in dorsal view, apical margin roundish in lateral view (Figure 1g). Fore wing with cross-vein cu-a joining cell 1M in basal 1/3, cross-vein 2r joining cell 2Rs in apical 1/4, cell 2Rs clearly longer than cell 1R₁, petiole of anal cell slightly shorter than cross-vein 1r-m; petiole of anal cell in hind wing 1/4 length of cross-vein cu-a. Lancet narrow and long, with 20 serrulae (Figure 1j), slightly oblique and sub-triangularly protruding, middle serrulae with 1 proximal and 3–6 distal teeth, subbasal teeth distinct and small, annular spine bands somewhat narrow, annuli 2× breadth of annular spine, the 7th–9th serrulae as shown in Figure 1k.

Male. Unknown.

Host plants. Unknown.

Distribution. China (Zhejiang).

Etymology. The specific name “*lishui*” is derived from Lishui City belonging to Zhejiang Province where the holotype specimen was collected.

***Macrophya minutithec* Wei & Nie, 2002**

Macrophya minutithec Wei & Nie, 2002. Insects from Maolan Landscape, 479. Type locality: China: Guizhou.

Diagnosis. This species is morphologically similar to *M. hainanensis*, i.e. the mesepisternum entirely black; basal margin of metabasitarsus black, otherwise pale yellow-

ish-brown; anal petiole in fore wing long; sheath 0.5× length of metabasitarsus.

Type material. Holotype. ♀, China, Guizhou, Mt. Maolan, alt. 750 m, 10.V.1999, Meicai Wei leg.; Paratypes. 6♀2♂, China, Guizhou, Mt. Maolan, alt. 750 m, 10–11.V.1999, Meicai Wei leg.; 2♀, China, Guizhou, Mt. Sanchahe, alt. 750 m, 11.V.1999, Meicai Wei leg.

Host plants. Unknown.

Distribution. China (Guizhou).

***Macrophya nigrospuralina* Wei, 2005**

Macrophya nigrospuralina Wei, 2005. Insects from Xishui Landscape, 480. Type locality: China: Guizhou.

Diagnosis. This species is morphologically similar to *M. lishui*, i.e. the apical antennomeres 7–9 of antenna entirely yellowish-white; center mesoscutellum with complete and long black stripe in longitudinal direction; hind femur mostly orange-brown, apex on dorsal surface with small macula; apex of fore coxa, apical 2/5 of middle coxa and apex of hind coxa with yellowish-white maculae; posterior margins of all abdominal terga with weak maculae, but not yellowish-white; lancet with 18 serrulae, roundish protruding, subbasal teeth minute, without proximal or distal teeth.

Type material. Holotype. ♀, China, Guizhou, Xishui County, Mt. Pingjiang-Linjiang, alt. 1500–1800 m, 2.VI.2000, Wei Xiao leg.; Paratypes. 3♀, same date as holotype.

Non type material. 1♀, China, Hubei, Mt. Shennongjia, Mt. Guanmen, 31°26.781'N, 110°23.373'E, alt. 1241 m, 13.VII.2008, Fu Zhao leg.

Male. Unknown.

Host plants. Unknown.

Distribution. China (Guizhou, Hubei).

***Macrophya zhaoae* Wei, 1997**

Macrophya zhaoae Wei, 1997. Entomotaxonomia, 19, Suppl., 81. Type locality: China: Zhejiang.

Diagnosis. This species is smaller than the other species in general morphological characters, i.e. the body length 10–11 mm; mesoscutellum with sparse large punctures, center with complete and long black stripe in longitudinal direction; hind femur and apex of hind tibia with black maculae; below pterostigma in apical 1/3 of fore wing with smoky macula; middle serrulae with minute teeth.

Type material. Holotype. ♀, China, Zhejiang, Mt. Tianmu, VI.1985, Hong Wu leg.; Paratype. 1♂, China, Zhejiang, Mt. Tianmu, Xianrending, 2.VI.1990.

Non type material. 1♀, China, Hubei, Yichang City, Dalaoling Forest Farm, 26.VII.2010, Hongquan Chen leg.

Host plants. Unknown.

Distribution. China (Hubei, Zhejiang).

Discussion

The *Macrophya zhaoae* group is the second smallest among the defined species groups of *Macrophya* Dahlbom, 1835 in terms of number of species. At present, five Chinese species belong to this group, including a new species described in this study from Zhejiang Province: *M. hainanensis* Wei & Nie, 2002, *M. lishuii* Li, Liu & Wei sp. nov., *M. minutitheca* Wei & Nie, 2002, *M. nigrospuralina* Wei, 2005 and *M. zhaoae* Wei, 1997. The included key and the distribution map of the *M. zhaoae* group (Figure 2) should facilitate the recognition and identification of the Chinese species.

As we know, the host plants of *Macrophya* species add up to six families and nine genera, and belong to Begoniaceae (*Begonia*), Caprifoliaceae (*Lonicera*, *Sambucus*), Euphorbiaceae (*Euphorbia*), Geraniaceae (*Geranium*, *Pelargonium*), Oleaceae (*Fraxinus*, *Ligustrum*) and Verbenaceae (*Clerodendrum*) (Li et al. 2018). However, we surmise that the *Macrophya zhaoae* group uses different host plants, and we hope that we will be able to find out the host plant in future research.

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